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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/586,115	06/02/2000	Rodolfo Milito	P3807	6216

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CENTRAL COAST PATENT AGENCY
PO BOX 187
AROMAS, CA 95004

EXAMINER

HIRL, JOSEPH P

ART UNIT	PAPER NUMBER
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2121

DATE MAILED: 12/09/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/586,115

Applicant(s)

MILITO ET AL.

Examiner

Joseph P. Hirl

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 11 September 2002.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-23 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-23 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED ACTION

1. This Office Action is in response to an AMENDMENT entered September 11, 2002 for the patent application 09/586,115 filed on June 2, 2000.
2. The First Office Action of July 31, 2002 is fully incorporated into this Final Office Action by reference.
3. The Examiner always interprets all claims in the broadest reasonable sense. Only the claims form the metes and bounds of the invention.

Status of Claims

3. Claims 1-23 are pending.

Response to Arguments

4. Applicant's arguments filed on September 11, 2002 related to Claims 1-23 have been fully considered but are not persuasive.

In reference to Applicant's argument:

Regarding claim 1, the Examiner states that Lakshman anticipates a first set of rules associating to the packets by values of the header fields, (Lakshman, p. 203, col. 2, lines 29-35). Applicant has carefully reviewed the portion of Lakshman and argues that the portion only describes that the packet filtering mechanism should parse a large portion of the packet header before a forwarding decision is made, resulting in the incoming packet being classified using a set of predefined rules. There is clearly nothing

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whatsoever in the teaching given in the portion that teaches association of specific header values to specific rules, as in applicant's claim.

Examiner's response:

The Examiner always interprets the claims in the broadest reasonable sense.

Simply stated, Lakshman anticipates the header rules association as acknowledged by the Applicant.

In reference to Applicant's argument:

The Examiner further states that Lakshman numbers intervals between break points in sequential binary numbers (as the applicant clearly claims), associates a subset of the first set of rules as applicable in each interval between break points on each axis, then considers a packet as a point in the N-dimensional space according to its header field values, locates the binary numbered interval into which the point projects on each axis by performing a search on each axis for the numbered interval into which the point projects on that axis, thereby determining rules applicable to the packet for that axis, and then determines the specific rules applicable to the packet from the subsets of rules by selecting those rules as applicable to the packet that apply to the packet on all of the N axes. The Examiner further notes that a set of break points constitutes an interval.

Applicant has carefully studied the portion of Lakshman (p. 208, col. 2, lines 10-34) cited and applied by the Examiner in support of the above statement. Applicant respectfully traverses the Examiner's above statement, and argues that Lakshman does not number intervals between break points in sequential binary numbers at all, and there is no teaching whatsoever in the above portion of Lakshman cited by the Examiner, or anywhere else in the teaching of Lakshman, of naming the intervals by numbering them in sequential binary numbers.

Examiner's response:

Again the Examiner interprets the claims in the broadest reasonable sense. The reference cited by the Applicant refers to Lakshman, Fig. 2 wherein the break points are identified by binary representation. A review of Fig. 2 clearly indicates that the binary representation is sequential. The concept of "naming" intervals is not found in specification, drawings or claims of the Applicant.

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In reference to Applicant's argument:

Now referring to Fig. 2 of Lakshman, and the description given in the portion of Lakshman above cited and applied by the Examiner, applicant argues that the illustration and description given of the functioning of the algorithm of Lakshman clearly does not read on all of applicant's limitations in the base claims. The rules are represented in Fig. 2 of Lakshman by two-dimensional rectangles that can be arbitrarily overlapped. The first step, or pre-processing step, of the algorithm projects the edges of the rectangles to the corresponding axis, the rectangles creating seven intervals in each axis. In the worst case the projection results in a maximum of $2n + 1$ intervals on each dimension. An N-dimensional bitmap is associated with each interval, and a bit in the bitmap is set only if the corresponding rectangle overlaps with the interval that the bitmap corresponds to. The packet, represented in Fig. 2 by point P 1 arrives to the system, and during the first online step the intervals in both axis that contain this point are located. In the second step the bitmaps are used to locate the highest priority rectangle that covers point P 1. After the logical-AND of the bitmaps, the first bit that is set in the resulting bitmap is that corresponding to rule 3, as shown in the Fig., which is the highest priority of rule, amongst all those overlapping point P 1.

Applicant now wishes to direct the Examiner's attention to applicant's Fig. 3, wherein a representation is illustrated of rules projected on an X-axis and a Y-axis, and a packet in process is represented by point X in the two-dimensional space, similarly to Fig. 2 of Lakshman. The point X is located by the field values for fields A and B, and, as in Lakshman, has been acquired by the system for the purpose of determining the rule which is to be used to process the packet. The upper and lower field value boundaries for each rule in this simple example are projected onto each axis, creating a series of break points on each axis, the break points establishing a series of intervals on each axis, also similarly to Fig. 2 of Lakshman.

Although only two fields, thus two dimensions, are used in the examples of applicant's Fig. 3 and also for Fig. 2 of Lakshman, it is noted that a packet may be represented by a point in N-dimensional space, such as in as many as five dimensions for Internet protocol version 4 (IPv4), and, as recognized by the skilled artisan, determining the applicable rule or rules in such a system of conventional art can become exponentially complicated. Parallel binary searches are typically performed to determine the interval on each axis within which a projection of the point falls.

Applicant's invention, however, provides advantages over the prior art in that, a unique contribution of a preferred embodiment of the present invention is in determining the best break points and methods to accomplish the search in the least number of steps. There are a number of ways in which one may select among the break points and conduct the search. One inefficient example of such a method is selecting among the existing break points without preference, comparing the selected break point value with the packet point projection, yielding where the point lies relative to the selected break point. Referring to applicant's Fig. 3, consider, for example, a first step on the X-axis using the break point 1C. A compare will show that the point 05 lies to the left of 1C, eliminating the interval from 1C to 1F. One may then select any one of the break points between 0 1 and 1 C , and continue to process, eventually isolating the correct interval. Another possibility, again with reference to applicant's Fig. 3, is to select break points considering the binary value of the break points, at a point that where the most significant bit of the X-value changes. In the example shown in applicant's Fig. 3, 0E is 01110 and 17 is 10111. In this scheme one would select 17 as the first break point, and the search continues by selecting break points on the axes were the second bit changes, the third bit changes, and so on the fifth bit.

The present inventors, however, have determined an improved process for determining the best break points and accomplishing the search in the least number of steps, electing to name the intervals by numbering them sequentially in binary, selecting the break points by the sequentially numbered intervals. Applicant now wishes direct the Examiner's attention to applicant's Fig. 2, wherein a table is illustrated which has been created for the intervals on the two axes, as in the example shown in applicant's Fig. 1. In the left most column of the table interval break points are shown, corresponding to the X-axis and Y-axis of applicant's Fig. 1, the interval break points being the end points for each interval. Binary numbers in

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ascending order from 0 are shown for each axis in the middle column of the table of Fig. 2. The intervals are numbered to provide, in a preferred embodiment of present invention, a unique way for structuring the process of determining into which interval a header value for a packet in process falls. The right most column in the table of Fig. 2 is the bitmap for the interval, which relates the rules that apply for that interval. As an example, again referring to applicant's Fig. 1, in the case of in interval number 001, from 0 to break point 01, the bitmap is 000, as no rule projects on the X-axis in this interval. The skilled artisan will be able to follow the break points, interval ordering and bitmaps for the rest of the X-axis and for the Y-Axis of Fig. 2 in this example.

The above scheme has a distinct advantage over systems of conventional art in that there are only three bits in the sequential interval numbers (in the example presented) rather than 5 bits to deal with in the axis values, as in Lakshman, requiring fewer steps and less hardware implementation for determining the best break points when compared to examples as described above for conventional art. In the embodiment of the present invention described in step-by-step progress in applicant's specification beginning on page 12, line 23, as each packet arrives to be processed in the packet-by-packet phase, the several steps are performed and the best rule is selected for that packet, then another packet is processed. If the rules change, the mapping of the rules to axes has to change as well (pre-processing phase) before further packets may be processed. Tables for multiple rule sets may be stored, and the correct table selected when rules change.

Upon carefully and thorough review of Lakshman, particularly the portions cited and applied by the Examiner to support the Examiner's rejections of applicant's claims, applicant is confident that nowhere in a reference of Lakshman is there any disclosure, suggestion or intimation of anything having to do with naming intervals by numbering intervals between break points in sequential binary numbers, or locating the binary numbered interval into which the point projects on each axis by performing a search on each axis for the numbered interval, thereby determining rules applicable to the packet for that axis, as is specifically recited in applicant's base claims 1 and 12. Lakshman clearly utilizes the break points in all of the hardware implementation, using the actual header values to which a rule applies in all of the hardware computations. Applicant's invention, however, uses nothing of the actual header values, instead using the sequential binary numbering of intervals in the calculations.

Examiner's response:

The Examiner interprets the claims in the broadest reasonable sense. Only the claims establish the metes and bounds of the invention.

The issue regarding "naming" has been discussed above. Lakshman's algorithm (Lakshman, col 2, lines 10-34) and the reference thereto of Fig. 2 apply. Rules are illustrated in Fig. 2 by 2-dimensional rectangles. Lakshman hardware implementation is not relevant to this discussion. The issues are focused on the Applicant's disclosure. Lakshman's prior art is allowed to facilitate other features beyond that of the Applicant.

Lakshman clearly anticipates the disclosure of the Applicant.

In reference to Applicant's argument:

Regarding applicant's independent claim 23, the Examiner's states in the instant Office Action that Lakshman anticipates conducting a first search on one or more axes, and using information from the first search to simplify further searching on remaining axes. Applicant has carefully reviewed page 209, col. 2, lines 56-62, and page 203, col. 2, lines 19-25 of Lakshman, and applicant can find no specific teaching or suggestion in either portion cited of simplifying a search comprising the steps of conducting a first search on one or more axes, and using information from the first search to simplify further searching on remaining axes, as is recited in applicant's claim 23. The teachings of the above portions of Lakshman actually have nothing to do whatsoever with the limitations of applicant's claim 23. Applicant therefore believes that claim 23 is also clearly patentable over Lakshman.

Examiner's response:

The Examiner interprets the claims in the broadest reasonable sense. The referenced section regarding Lakshman process searches one dimension to find the interval i on set P_j of some k dimension (Lakshman, col 2, lines 58-59) which is the equivalent of the Applicant's conducting a first search on one or more axes. Obviously, once Lakshman has executed the binary search for the initial value for j , the following process is simplified since only $j-1$ remaining dimensions need to be searched. Again Figure 2 of Lakshman applies.

Claim Rejections - 35 USC § 102

5. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

Claim 1 – 23 are rejected under 35 U.S.C. 102(b) as being anticipated by Lakshman et al (ACM 1-58113-003, referred to as **Lakshman**).

Claim 1

Lakshman anticipates a first set of rules associating to the packets by values of the header fields (**Lakshman**, page 203, col 2, lines 29 – 35); and a classification system for selecting specific rules in the set of rules as applicable to a specific packet (**Lakshman**, page 203, col 2, lines 29 – 35); characterized in that the classification system projects the first set of rules as N-dimensional entities on N axes in N-dimensional space, marking the beginning and ending value on each axis for each rule as a breakpoint, numbers intervals between breakpoints in sequential binary numbers, associates a subset of the first set of rules as applicable in each interval between breakpoints on each axis, then considers a packet as a point in the N-dimensional space according to its header field values, locates the binary numbered interval into which the point projects on each axis by performing a search on each axis for the numbered interval into which the point projects on that axis, thereby determining rules applicable to the packet for that axis, and then determines the specific rules applicable to the packet from the subsets of rules by selecting those rules as applicable to the packet that apply to the packet on all of the N axes (**Lakshman**, page 208, col 2, lines 10 – 34; Examiner's Note: a set of breakpoints constitutes an interval).

Claims 2, 13

Lakshman anticipates the search performed on each axis is a binary search conducted by selecting breakpoints at which the bits change for the binary numbered intervals (**Lakshman**, page 209, col 2, lines 59 – 62).

Claims 3, 14

Lakshman anticipates the search performed on each axis is a quaternary or higher-level M-ary search, where M is a power of 2, conducted by selecting breakpoints at which the bits change for the binary numbered intervals (**Lakshman**, page 209, col 2, lines 59 – 62; Examiner's Note: quaternary is a looped binary search which has rule depth limits).

Claims 4, 15

Lakshman anticipates association of applicable rules in each numbered interval is made by associating a binary string with each interval, with one bit dedicated to each rule. (**Lakshman**, page 208, col 2, lines 10 – 34).

Claims 5, 16

Lakshman anticipates the rules are associated to bit positions in the binary string by priority, the order of priority according to bit significance, and a final rule is selected by the most significant 1 in the matching rules. (**Lakshman**, page 208, col 2, lines 10 – 34).

Claims 6, 17

Lakshman anticipates the applicable rules are found by ANDing the binary strings determined for each axis over all axes. (**Lakshman**, page 208, col 2, lines 10 – 34).

Claims 7, 18

Lakshman anticipates at least one hardware pipeline for conducting the search on an axis, the pipeline comprising first, second, and sequential modules for

accomplishing increasingly particular portions of the search, wherein, after the first module of the sequential modules is used, determined values from the first module pass to the second module, and values for a second packet enter the pipeline at the first module, the pipeline operations proceeding thus sequentially. (**Lakshman**, page 208, col 2, lines 36 – 39; page 209, col 1, lines 1 – 26).

Claims 8, 19

Lakshman anticipates parallel pipelines with one pipeline dedicated to searching on each axis in the N-dimensional space, wherein searches are conducted for applicable intervals simultaneously on each axis. (**Lakshman**, page 208, col 2, lines 36 – 39; page 209; col 1, lines 1 – 26).

Claims 9, 20

Lakshman anticipates applicable rules for each interval on each axis are represented by individual bitmaps, with each rule assigned a bit position, and wherein the outputs of the parallel pipelines, being the numbered interval on each axis into which the point for a packet projects, are exchanged for the associated bitmaps, which are then ANDed to determine the applicable rules. (**Lakshman**, page 208, col 2, lines 36 – 39; page 209; col 1, lines 1 – 26; page 208, col 2, lines 10 – 34).

Claims 10, 21

Lakshman anticipates searching is interleaved, results of searching on one or more axes being applied to other axes before searching on the other axes. (**Lakshman**, page 207, col 2, lines 55 – 57; Examiner's Note: Lakshman, using the best method related to the development of the system of Claim 1, extracts the jth element of every

filter for all n filter rules where such element's reference must exceed one on the j th axis. In the conventional mathematical notation, if i is less than 1 or not defined, the respective j th axis has no value for the referenced rule. Since there must be an i th value for each rule in the j th dimension, Lakshman's algorithm anticipates an efficient search. The mathematical converse applicable to Lakshman's notation sets aside the rule covering the instance wherein the rule does not have an interval on one or more k axes.)

Claims 11, 22

Lakshman anticipates rules that are found by search to not apply on one or more axes are not considered in searches conducted on the other axes (**Lakshman**, page 207, col 2, lines 55 – 57; see above notation).

Claim 12

Lakshman anticipates projecting the rules as N -dimensional entities on N axes in dimensional space (**Lakshman**, page 207, col 2, lines 55 – 60); marking the beginning and ending value on each axis for each rule as a breakpoint (**Lakshman**, page 208, col 1, lines 7 – 10); numbering intervals on each axis sequentially with binary numbers; identifying those breakpoints at which bits in the interval numbers change (**Lakshman**, page 208, col 2, lines 10 – 34); associating a subset of the rules as applicable in each interval on each axis (**Lakshman**, page 208, col 2, lines 10 – 34); considering a packet as a point in the N -dimensional space according to values of the header fields for the packet (**Lakshman**, page 203, col 2, lines 29 – 35); determining by search the binary numbered interval on each axis into which the packet point projects (**Lakshman**, page

203, col 2, lines 29 – 35; page 208, col 2, lines 10 – 34); substituting the subset of rules that apply for each determined interval (**Lakshman**, page 208, col 2, lines 10 – 34); and selecting those rules as applicable to the packet that associate to the packet on all of the N axes (**Lakshman**, page 208, col 2, lines 10 – 34).

Claim 23

Lakshman anticipates conducting a first search on one or more axes (**Lakshman**, page 209, col 2, lines 56 – 62); and using information from the first search to simplify further searching on remaining axes (**Lakshman**, page 203, col 2, lines 19 – 25).

Conclusion

6. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any

extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Correspondence Information

7. Any inquiry concerning this information or related to the subject disclosure should be directed to the Examiner, Joseph P. Hirl, whose telephone number is (703) 305-1668. The Examiner can be reached on Monday – Thursday from 6:00 a.m. to 4:30 p.m.

If attempts to reach the Examiner by telephone are unsuccessful, the Examiner's supervisor, John Follansbee can be reached at (703) 305-8498.

Any response to this office action should be mailed to:

Commissioner of Patents and Trademarks,
Washington, D. C. 20231;

or faxed to:

(703) 746-7239 (for formal communications intended for entry);

or faxed to:

(703) 746-7240 (for informal or draft communications with notation of "Proposed" or "Draft").

Hand-delivered responses should be brought to:

Art Unit: 2121

Receptionist,
Crystal Park II,
2121 Crystal Drive,
Arlington, Virginia.

Joseph P. Hird



November 6, 2002

Wilbert L. Starks, Jr.
Primary Examiner
Art Unit - 2121

